Seawater Desalination

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Presentation Outline

- Introduction
- General Overview
- Historical Development
- Recent Development and Breakthroughs
- Projects (Worldwide, Southern California/Others)
- Other Desalination Projects
- Central Valley Irrigation Water Desal
- Key Issues/Constraints
- Conclusion

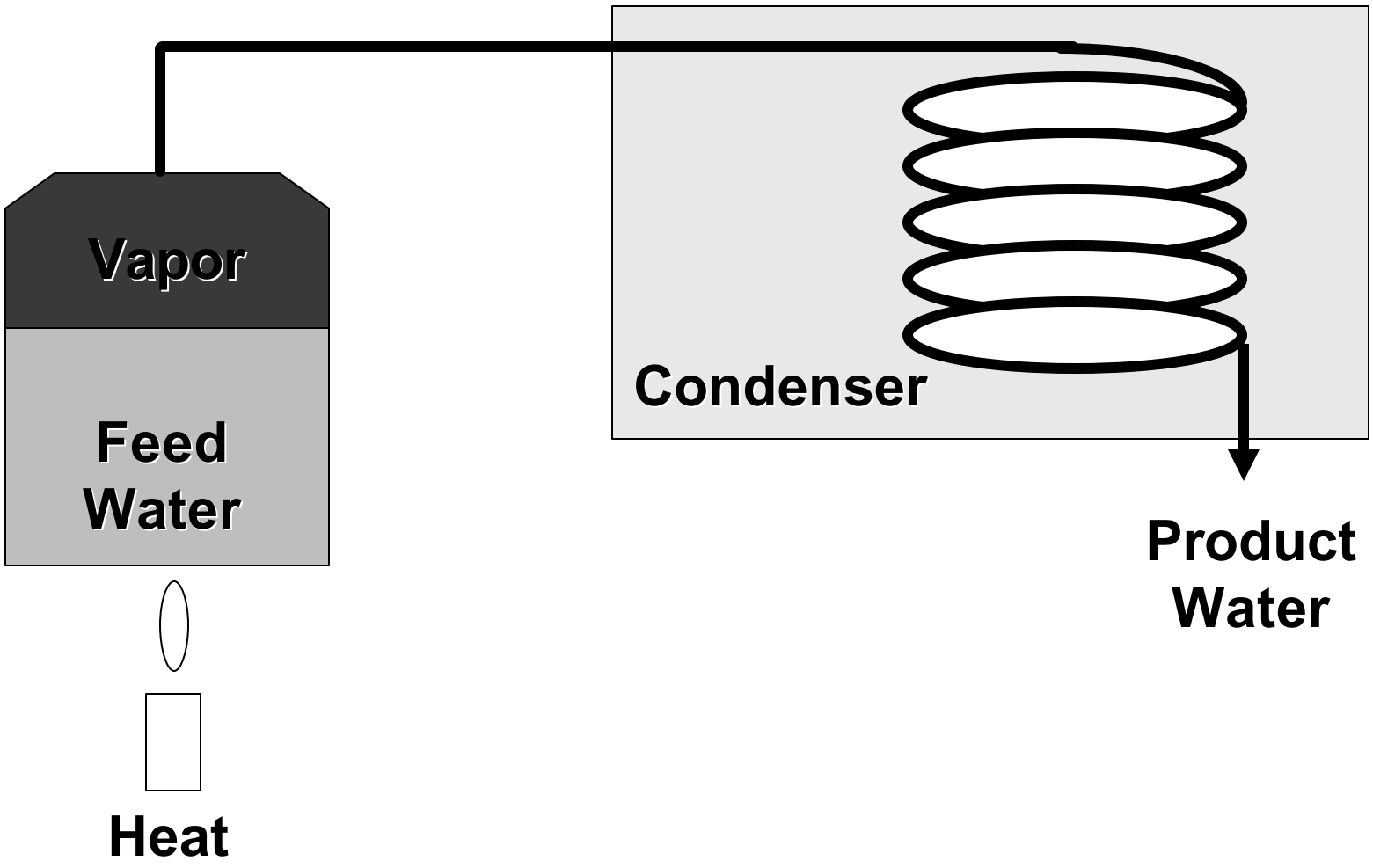
SEAWATER DESALINATION
Introduction

- Reliability – Drought-Proof / Emergency Supply
- New Supply / New treated water source
- Cost Competitive with other resource options
- Potential Collocation Benefits
  - Use of Existing Infrastructure
  - Power available on-site
- Avoided Facility Costs
- Water Quality

SEAWATER DESALINATION
General Overview

- Seawater TDS = 35,000 mg/l
- Technologies
  - Thermal Processes
  - Membrane Processes
- Current Worldwide Application
  - Middle East
  - Mediterranean
  - Coastal Power Stations/Indust. Use
  - Island/Resort Use
- Continuing Shift to Membrane Processes

DISTILLATION

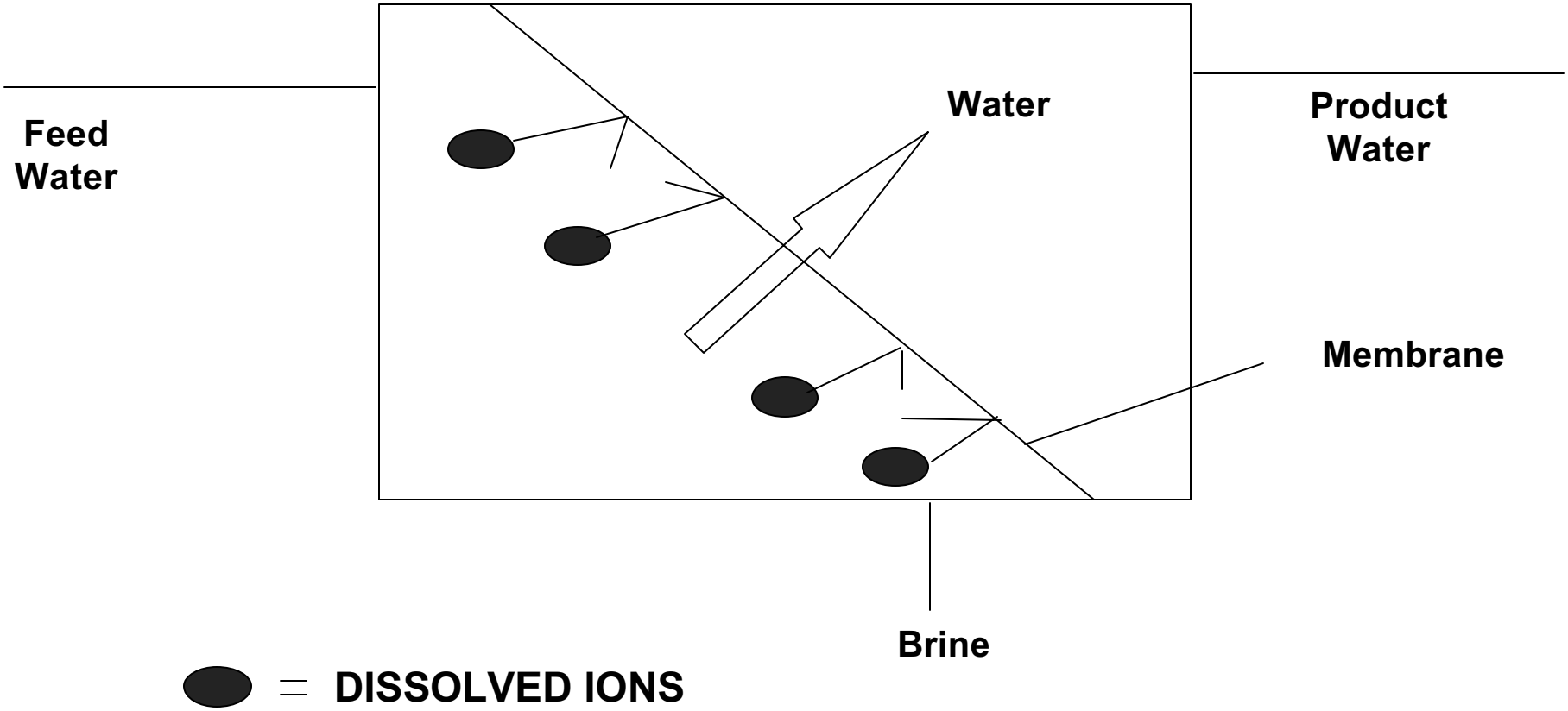


World's Largest Seawater Desalination Facility

Al-Jubail Plant, Saudi Arabia

250 mgd

REVERSE OSMOSIS



Historical Developments

- Early Thermal Desalination Processes
- U.S. Government Funding of Desalination Research
- 1960's Development of Reverse Osmosis
- 1978 Large-scale Installation of Seawater RO

First Spiral Wound Reverse Osmosis Module

General Atomic (San Diego, CA)
circa 1964

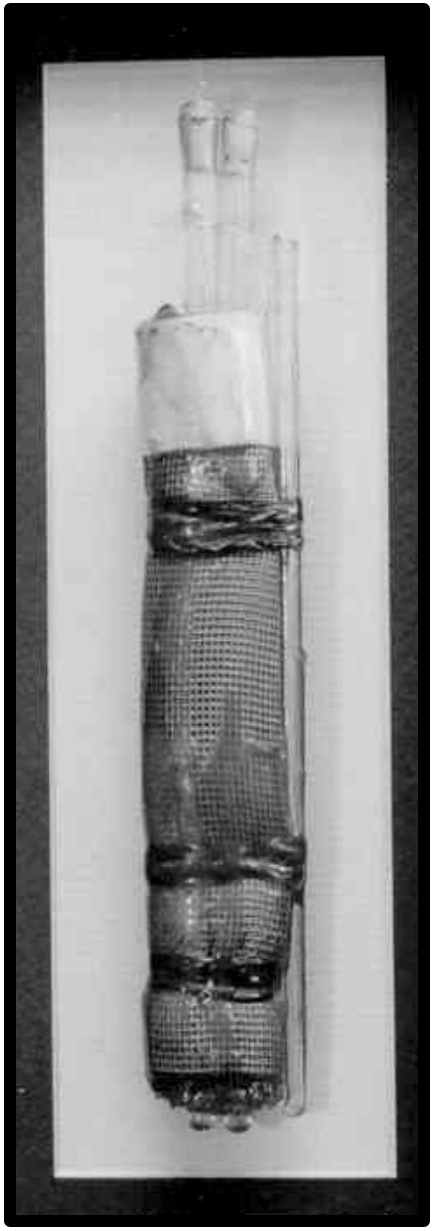
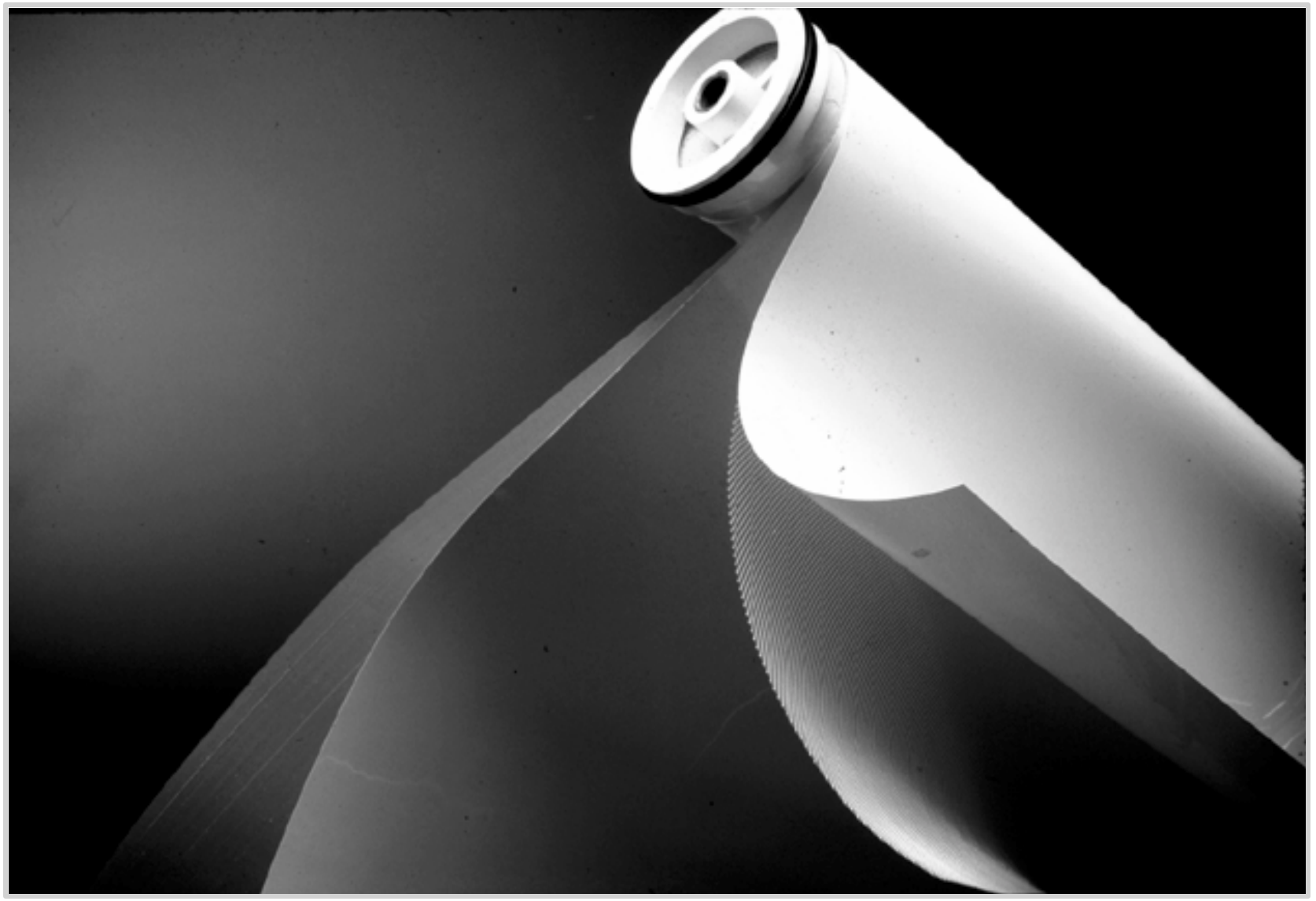
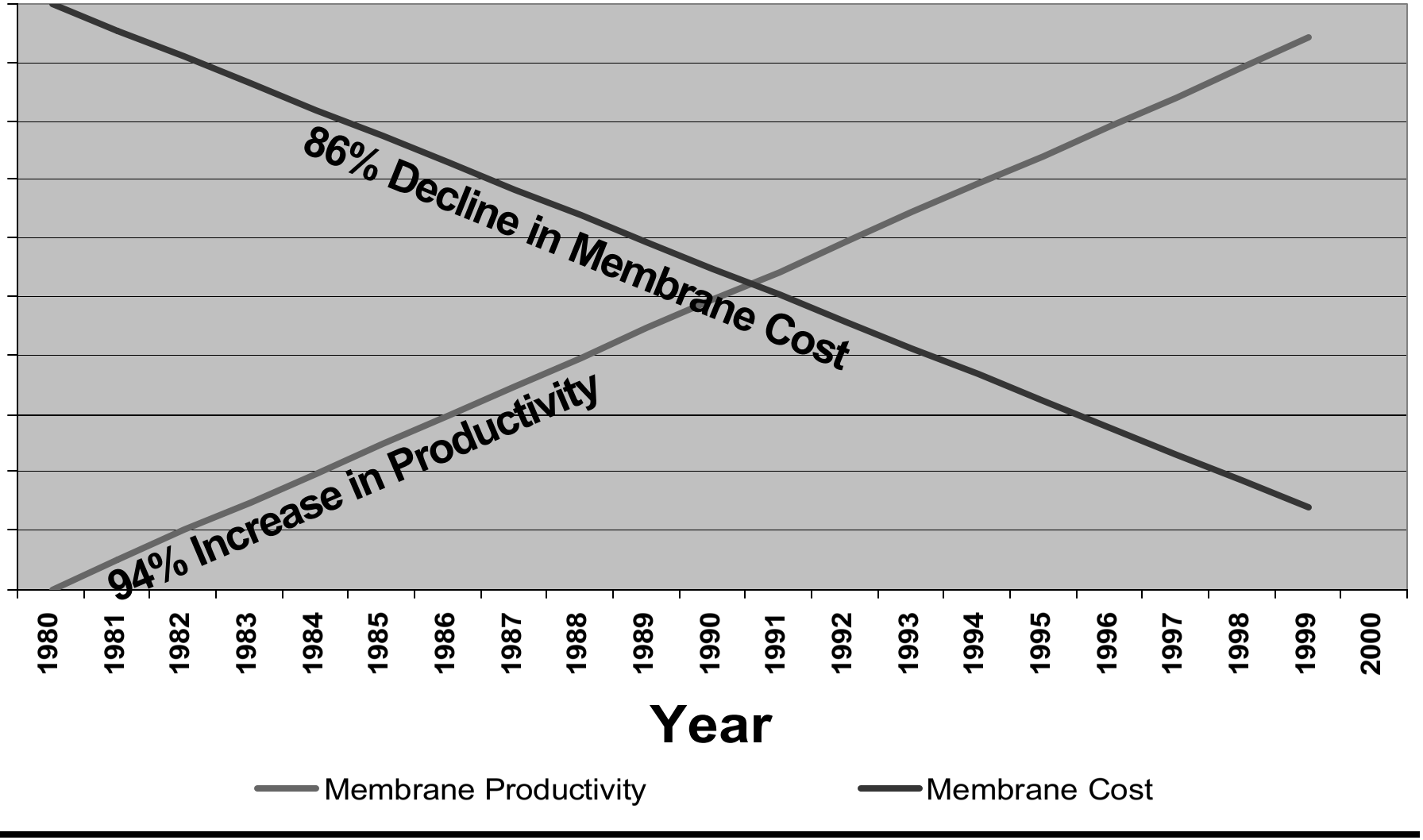


Photo courtesy of Fluid Systems Corporation

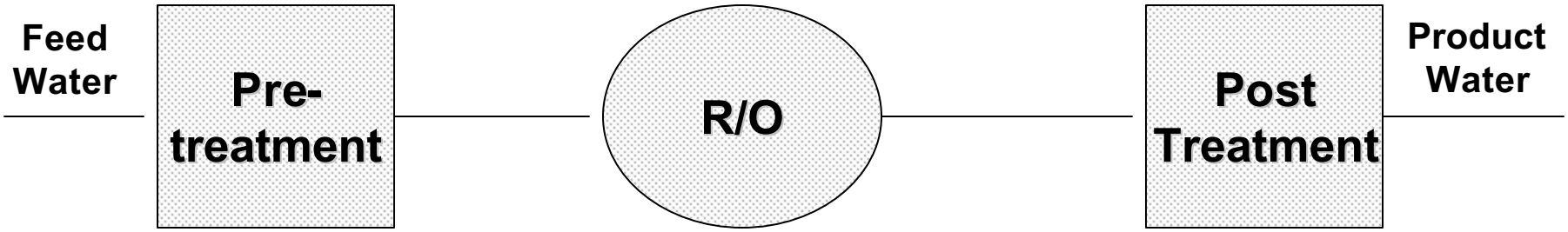
RO Element



Membrane Productivity vs Cost



SEAWATER RO
TYPICAL PROCESS BLOCK DIAGRAM



- Conventional, or
- Membrane filtration
- Cartridge Filtration
- Antiscalant

- High Pressure RO Feed Pumps
- RO Membranes 50 - 60% Recovery
- Energy Recovery/ Brine Discharge

- Chemical Addition
- Disinfection

SEAWATER DESALINATION

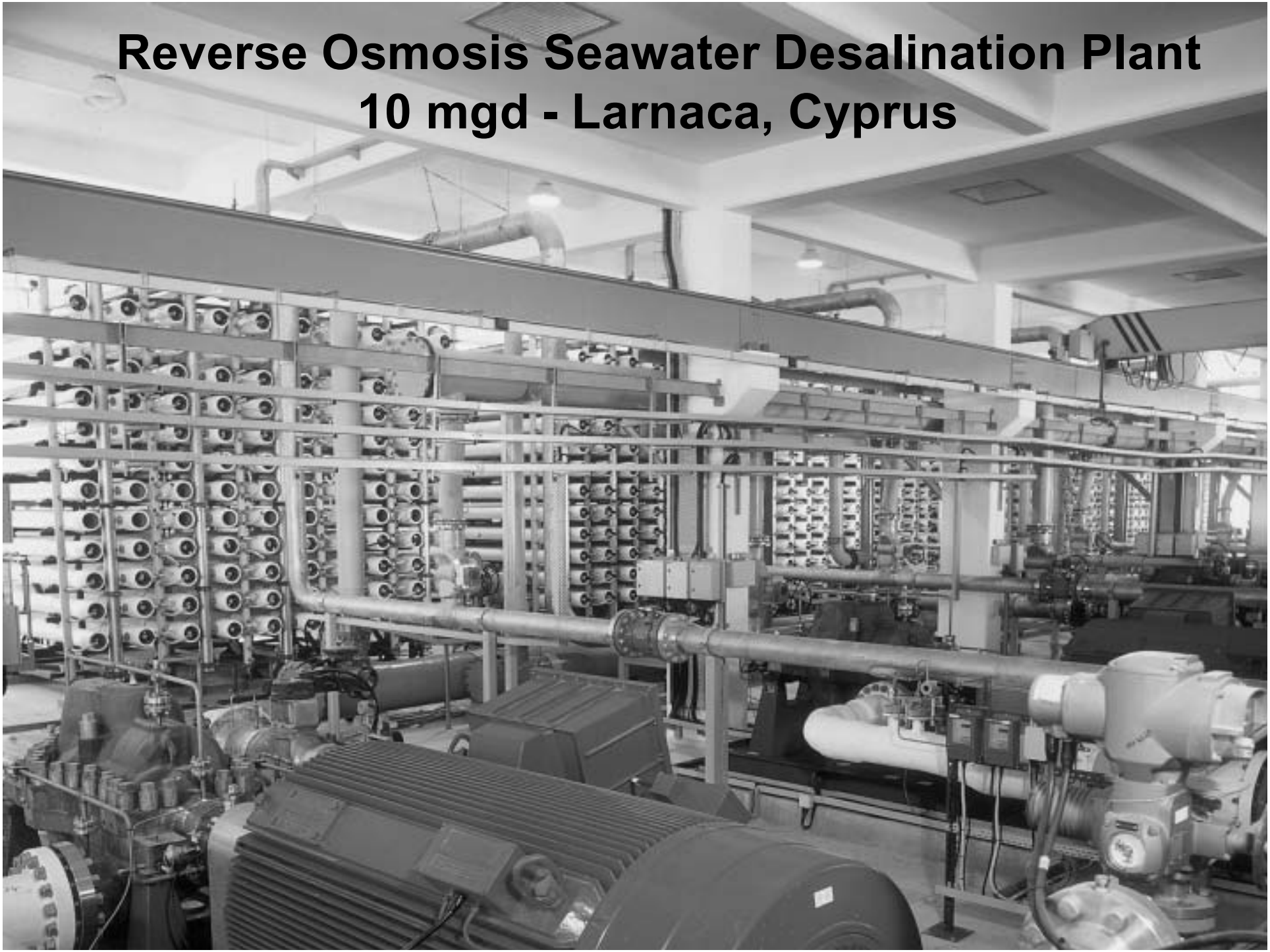
Worldwide Project Overview

SEAWATER DESALINATION

Major Ongoing RO Projects Worldwide

Location	Capacity	Completion
Trinidad and Tobago	**28.8 mgd**	**Operating**
Carboneras, Spain	**32 mgd**	**Operating**
Larnaca, Cyprus	**14.3**	**Operating**
Cartagena, Spain	**17 mgd**	**2003**
Fujairah, UAE	**45 mgd**	**2003**
Ashkelon, Israel	**72 mgd**	**2004**
Tampa Bay,Florida	**25 mgd**	**December 2002**

Reverse Osmosis Seawater Desalination Plant
10 mgd - Larnaca, Cyprus



SEAWATER DESALINATION

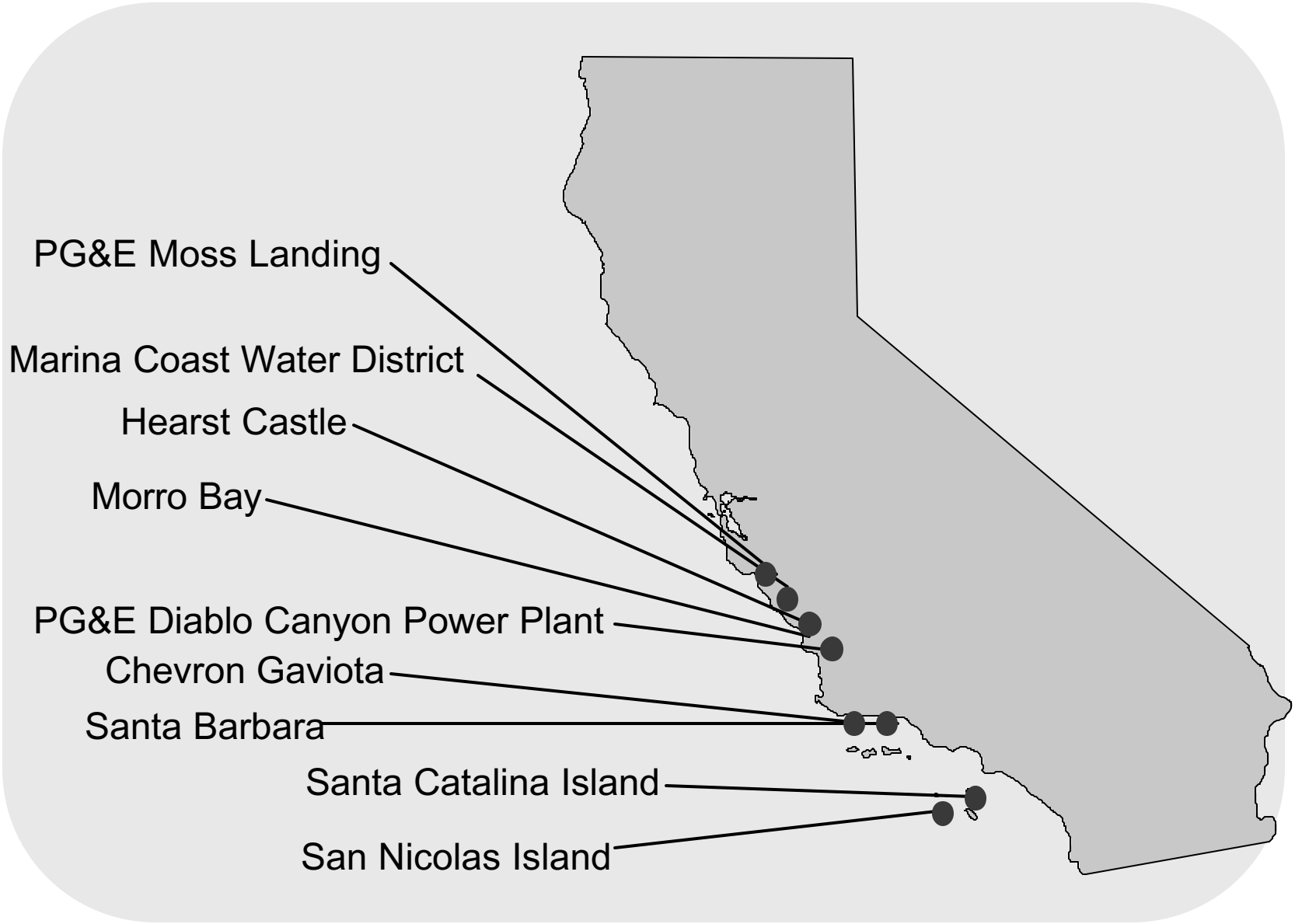
Major Ongoing Projects

Tampa Bay, Florida

- **Contracting Agency- Tampa Bay Water**
- **Initial Capacity - 25 mgd**
- **Expansion to 35 mgd**
- **Process-SWRO**
- **Avg. Feedwater TDS - 26,000 mg/l**
- **Cost of Water- Approx..$ 600 /AF**
- **Water price adjusted with inflation, electricity and chemical indices**

- **Construction Contractor – Covanta**
- **Current Status – 85 Percent Complete**

California Seawater Desalination Experience



Diablo Canyon Power Plant California

- 576,000 gpd Seawater RO Desalination
- In operation over 10 years

Photo Courtesy of IONICS

Seawater Desalination Projects Proposed for Southern California

	West Basin	Long Beach	LADWP	MWDOC	SDCWA
Size (mgd)	20	9	12	25	50
Location	El Segundo or Redondo Beach	Within Long Beach	Scattergood	Dana Point Or San Onofre	Carlsbad
Timeline	2008	2009	2009	2008	2006
Capital Cost	$130 million	$62-$92 million	$70 million	$114-$140 million	$272 million
Unit Cost/AF	$904	$711-$1,171	$1,033	$860-$1,007	$909

DESALINATION
Other Types of Desalination Projects

- Brackish Groundwater
  - Use existing, unused groundwater resources
  - Concentrate Discharge
  - Cost
- Recycled Water
  - Meet Desired Water Quality
  - Maximize Reuse
  - Cost
- Surface Water
  - Colorado River
- Agricultural Return

CENTRAL VALLEY IRRIGATION WATER DESALINATION

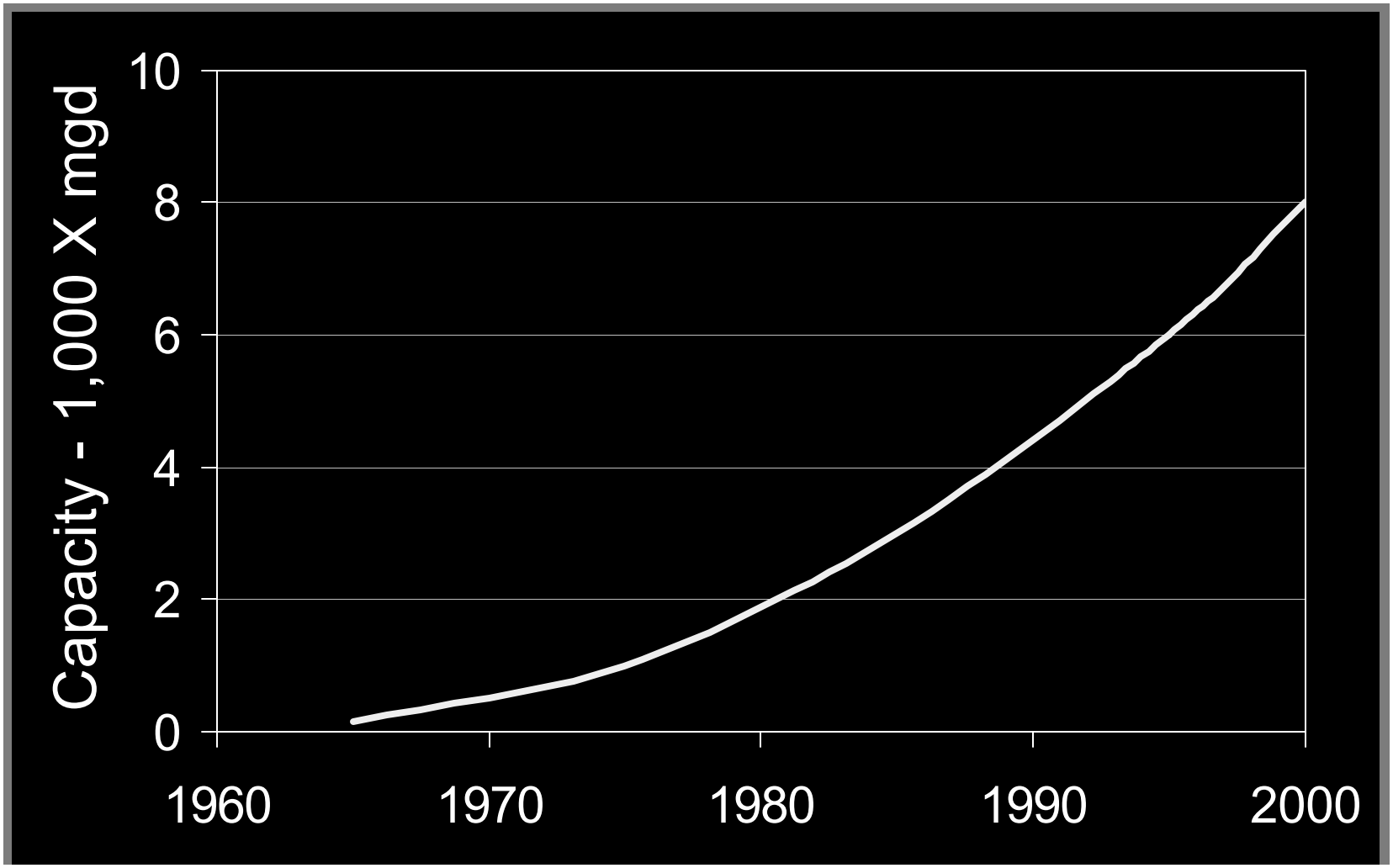
SEAWATER DESALINATION
Key Issues/Constraints

- Facility Siting Constraints
- Proximity to Existing Distribution System
- Technology Advances
- Cost Versus Other Resources
- Cost / Availability of Power
- Wintertime Demand Limitation
- Water Supply / Brine Discharge Permitting

SEAWATER DESALINATION
Conclusion

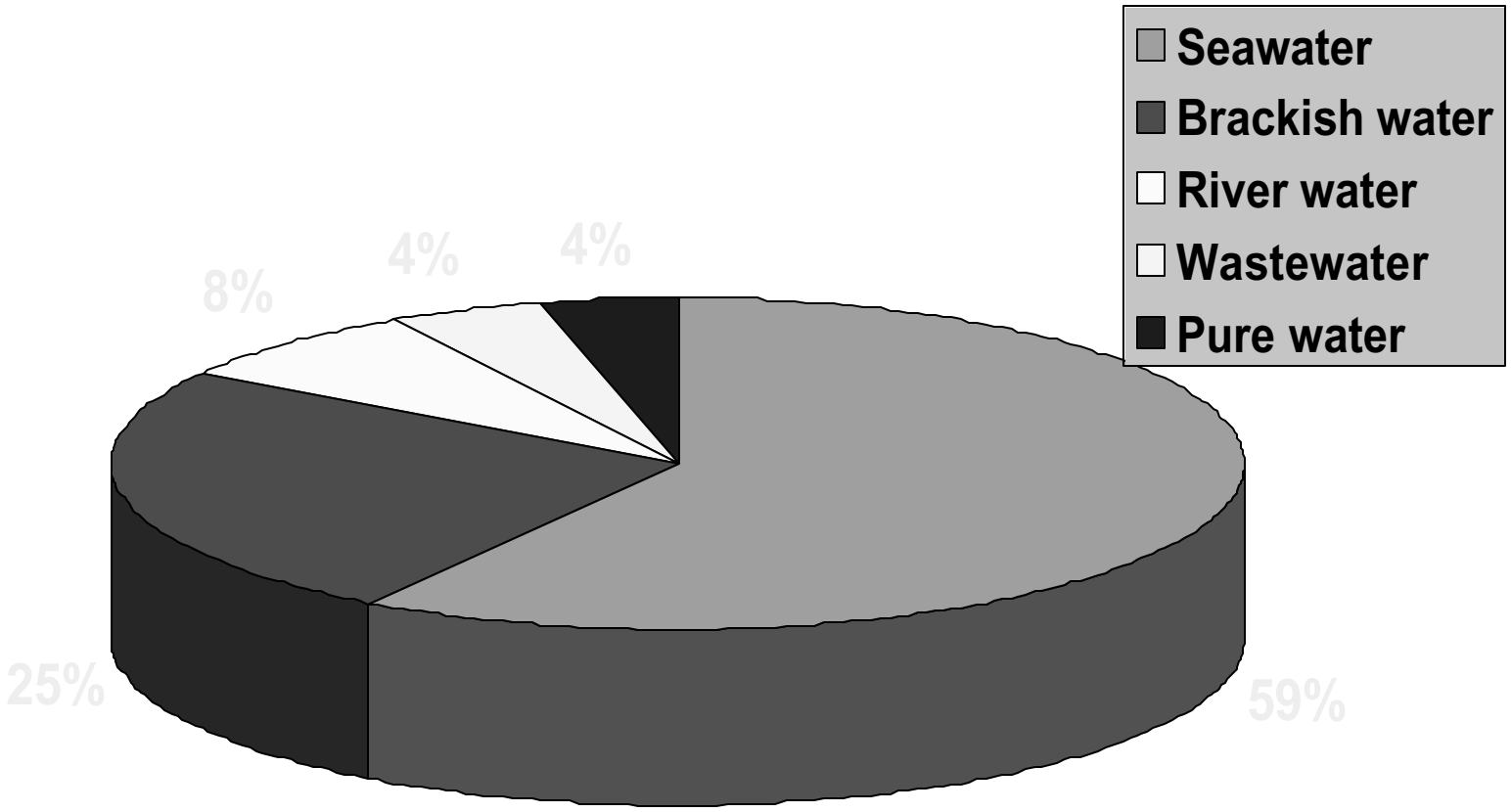
- Recent events will make seawater and brackish water desalination important parts of Southern California supply
- Irrigation water desalination is being practiced in parts of California
- There are opportunities for the rest of California to increase the use of desalination
- While there are significant issues to be resolved, desalination could play an important role in the CALFED examination of water supply options.

Total Installed Capacity of Desalting Facilities



IDA Worldwide Desalting Plants Inventory, May 2000

Global Desalting Capacity by Source



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